about 1300 yards in length. These sixteen tubes placed end to end, are separated by sixteen telegraph offices, the distance between each of which is traversed in rather less than a minute. The carriages might be sent more rapidly but the speed mentioned is found quite sufficient The oldest part of the work was constructed during the time of the Empire and consists of six tubes forming an almost regular hexagon. These tubes are traversed every fifteen minutes by *trains* of small carriages or boxes which move with the sun.

On this central system are grafted two branch systems and three single lines. Counting stoppages the trains travel at the rate of more than a mile in five minutes It is said that, when properly delivered, a message should not take longer than when sent in a cab by a special messenger. The *trains* are propelled by atmospheric pressure which is obtained by means of an ordinary air-pump piston. The manner in which the carriages are placed in the tubes is shown clearly in the engraving. The despatch and reception of trains is communicated from station to station by electric telegraph signals. The simplicity of the operations is manifested by the fact that three men suffice for the work of the central station, one of whom is also employed occasionally as messenger. The principal work of the system, as may be gathered from its name is the distribution through Paris of telegrams from the provinces.

GOODS LOCOMOTIVE AT THE VIENNA EXHIBITION.

We illustrate on page 112 one of the numerous locomotives exhibited at Vienna. This is an eight-coupled engine constructed for mountain service on the Royal Hungarian State Railways. The cylinders of this engine are outside, and are 20½ in. in diameter, with 2 ft. stroke, the piston rods being carried through the front covers. The wheels are coupled by outside cranks, and are 3 ft. 6½ in. in diameter, while the wheel base is 11 ft. 9¾ in., the trailing axle having lateral play to give increased flexibility to the engine. The diameter is 4 ft. 9½ in. It contains a large number of tubes, namely, 223, these being $2\frac{3}{4}$ in. in diameter by 15 ft. 3¾ in. in length between tube plates. These tubes give an external heating surface of 1823 9 square feet. The fire-grate area is 21 52 square feet, and the steam pressure 8½ atmospheres effective, or 125 lbs. per square inch. The weight of the engine of which we are now speaking is 41 tons empty, and 46 tons in working order, 10¾ tons of this latter weight resting on the leading wheels, and 11¾ tons on each of the other pairs. The axle boxes of the second and third pairs of wheels are, we should state, connected by compensating beams, a single spring on each side, arranged between the plates of these beams serving for both axles.

BRONZING AND VARNISHING PLASTER FIGURES.—These should be sized first, and painted with color according to the colored bronze required, as red, white, green, yellow, black, &c. Before the colors are thoroughly dry, that is, when they feel "tacky," the prominent parts should be bronzed with bronze powder, applied by a piece of chamois leather. Varnish afterwards with some quick drying varnish.

STRAW-BURNING PORTABLE ENGINE AT THE VIENNA EXHIBITION.

We illustrate, from *Engineering* on page 100 the portable straw-burning engine of Messrs. Ransomes, Lunn and Head of Ipswich, England. This engine has been an object of special attraction to the great grain growers of Western Europe. An engine of this kind would be of small service in the densely peopled parts of this continent and of Europe, but there are vast grain producing areas in America where such a machine would be invaluable. They are regions where straw is so abundant, and where the surrounding circumstances are such that it is rendered valueless. In such regions steam has hitherto been little employed for agricultural operations—not because its advantage over animal power was disputed, but on account of the impossibility of obtaining coal or wood as fuel for the engines, except at a cost which would render their use almost prohibitive.

The idea of burning the straw as fuel to raise steam is not quite new. Some years have elapsed since it was tried, and not wholly unsuccessfully, in Russia, and after a very primitive fashion. The wheels next to the fire-box of the locomotive engine were taken off the ash-pan and fire bars removed; a huge pit was sunk in the ground lined roughly with brule or stone, if procurable; a sort of flue funnel at one side, just the area of the interior of the fire-box of the engine, which was then placed right over this. The pit was filled with straw that was set on fire, and continually fresh straw was thrown in. The fire-box and tubes—in fact, the whole boiler and engine—became thus only a flue prolonged from over this straw furnace. Steam was gently kept up, but the waste of heat was great, the supply of straw immense, as was the labour of bringing that to the immovable point where the pit was once for all formed: and the exterior of the fire-box, indeed the whole engine, became so heated as often to be destroyed, and always rapidly injured.

So matters stood until Messrs Ransomes and Co. turned their attention to the problem which they have now so completely solved, namely, to adapt to the ordinary locomotive engine such arrangements as should enable it to be worked steadily and to its full power with straw fuel, these arrangements being as simple as possible, as alone suited to the rude people who are to manage them, involving the least possible amount of change or addition to the ordinary engine—of such a character that the engine can be, with very insignificant amount of charge, restore to its condition for burning coal, timber, or any other fuel. These conditions fulfilled, it is obvious that besides the abolition of the waste and technical difficulties of the pit-burning method, the great advantage would be secure that the locomotive now could follow its fuel in place of the fuel having to be brought from a distance to supply it. This problem, in all its conditions, has been most perfectly solved by Messrs. Ransomes and Co, and by means which are strikingly simple. We have examined an eight-horse (nominal) locomotive fitted for straw burning, and seen the engine for some time at work, applied to a dynamometer brake, which gave a resistance requiring the steady application of twenty-horse actual power to overcome it.

The following constitutes the arrangements to adapt an ordinary engine of this class to work with straw fuel. The engine is constructed with a fire-box larger than that needed for coal fuel—in this case it is one simply 1ft. *longer* than that for coal The fire-bars are taken out, and three or four light wrought iron cross bars about 4 in. apart supply their place. To the fire-door opening of the fire-box a cast iron mouthpiece is attached, carrying two or three small doors for inspection of the fire, and in and close to and beneath these, a pair of gathering, or "finger rollers," placed with their axes parallel, horizontal, and transversal, are arranged. These are geared together, and can be worked at the slow speed needed either by hand, by a winch handle, or by a strap and pulley, by the engine itself. A flat shoot, or tray, much like that of a common chaff-cutting machine, extends for 4 ft. or 5 ft. outwards from the rollers, in width equal nearly to their length, and open on top. Beneath the wide grille of bars described as taking the place of the fire-bars, is an ash-pan, open to the front end of the engine; across the open mouth of this, and above the level of the grille, is a small tube perforated with minute holes, which discharge in little vertical threads, a small amount of water supplied from a pipe led from the ordinary feed pump of the engine. This is the entire apparatus. To start to work the fire-box is moderately filled with straw, led into it from between the finger rollers. This is ignited, and the supply of straw is kept up by continuing to turn these rollers by hand, drawing in straw, fed into the shoot by the stoker, until steam is got up. As soon as this occurs the strap pulley keeps the finger rollers going, and all that is needed is to keep up the supply of straw by the shoot. Such is the entire apparatus. The blast pipe in the funnel supplies the draught in the usual way. Nothing appears to escape from the funnel but a white cloud, chiefly of watery vapour. The consumed straw does not, as might be expected, form a dense glassy slag of the silica and potass or soda contained in it naturally, but falls to the bottom of the ash-pan as a dusky flock or wig—the *pas udomorpha*, so to say, of the straws. This is little coherent, and when it accumulates the *grille* or ash-box is cleared of it by a rake or shoe provided to be worked from the feeding end of the fire-box. On the occasion of our inspection, the boiler being full, the water at the temperature